

Zoological Parks and Aquariums—Bridges of Learning

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Charles Lindbergh said “the Human Future depends on our ability to combine the knowledge of science with the wisdom of wildness” . . . nature. Wise words. It is evident from this gathering of respected leaders from state and Federal government, industry, academia and the environmental community, that we acknowledge and agree with the wisdom of this statement.

The richness and diversity of our natural resources promote a multitude of uses that are deserving of responsible stewardship. Technology has made many important advances and improvements for mankind through the manipulation of the physical and biological elements of our biosphere. And yet, new technology has brought with it some problems, i.e., atomic energy/nuclear war, pharmaceuticals/illegal drugs, chemicals/toxic wastes, space exploration/tragic accidents, and fears that genetic engineering will bring us Aldous Huxley’s “brave new world.” But the benefits of technology overcompensate for the negatives. And because progress is an on-going process, we must continue to monitor existing programs, increase our research capabilities, and where necessary, make programmatic readjustments. We must prove that technology is not poison.

From experience, we at Sea World know

that constructive progress can best be made in an atmosphere of mutual concern and cooperation. The Charles A. Lindbergh Symposium “Technology and Environment: The Search for Balance,” is a timely and important dialog on this important subject. It is my hope that this and other forums of its kind will be successful in promoting a thoughtful, cooperative and constructive discussion of the important promises that science and technology hold for the world in 1986 and beyond. Let us interrelate our areas of expertise and work with one another . . . collectively, to develop safe, new technologies. We must never give up our hopes of understanding and improving our world . . . in striking a balance.

Zoological parks and aquariums in the U.S. have an abiding interest in the implementation of Charles Lindbergh’s philosophy. We approach this from a standpoint of providing to the public education, recreation and cultural enjoyment through the scientific study and conservation of wildlife. In this way we endeavor to promote a greater awareness, understanding, and appreciation of wildlife and their environment. We do this with the hope of contributing to a more informed and responsive citizenship in tomorrow’s technological society. At the same time our

roles in biological research, and our very significant commitment to the provision of sanctuary for endangered and threatened wildlife, are undisputably important.

That, you think, seems a bit overwhelming? Sometimes we think so as well. What, then, keeps all this in focus? *Learning*. The goal of every institution is to become a bridge between its visitor, staff, and the natural environment. We cross that bridge as "learners." From the first-time visitor to the long-time research director, there are functions at work within these institutions that motivate learning. These functions are research, education, and recreation. Obviously, each function must be approached within differing perspectives. But because the goal is learning, there is no conflict in these differing perspectives.

Today I wish to share with you the integral roles these functions have played in advancing "the knowledge of science with the wisdom of nature."

Research Function

The problems of conserving threatened species are enormous. The U.S. Endangered Species Act lists a conservative 828 species, 331 of which are found in the U.S. But the Convention on International Trade in Endangered Species, the International Union for the Conservation of Nature and Natural Resources, and other international organizations list even more.

U.S. zoological institutions are making important contributions to international conservation through captive breeding programs, scientific research, and other types of conservation efforts. These efforts call for coordination and cooperation among all institutions concerned with a particular captive species. Increasingly, the community will work together, as consortiums, to fund large and expensive field projects, as well. Captive propagation programs make contributions to international conservation objectives by 1) provision of alternative refuge for species fac-

ing extinction due to loss of habitat, 2) provision of animals where and when appropriate for repopulation of natural habitat, and 3) when the odds no longer favor survival, to delay extinction through captive propagation for the purpose of conservation/education programs, i.e., as living monuments to a species extinct in its free state.

In addition to the intrinsic reasons for our efforts, species should be saved from extinction in order to maintain ecosystem stability. And, of course, the disappearance of any species is a tragic loss of scientific information with potential application to future human needs.

Species helped by zoological breeding projects include the Pere David deer, Przewalskii's horse, the European bison, Nene goose, snow leopard, Humboldt's penguin, trumpeter swan, black rhino, hippopotamus, tapir, okapi, addax, golden lion tamarin, and Bali mynah. The list grows as more and more institutions become successful in preserving the genetic integrity of other species in jeopardy. Conservation programs conducted in captive environments require a concerted effort and expense, and they require time.

In order to be viable for long-term captive propagation programs an adequate number of genetically-diverse animals must be available for reproductive management. Because inbreeding is always a potential problem, the species must be reproductively manipulated on a total captive basis. Breeding must be by computation rather than by chance. Breeding by whim leaves the species susceptible to complications resulting from a lack of genetic diversity, and adaptability over the long run is jeopardized.

While standard breeding procedures are still practiced by most institutions, we recognize that high-tech means of improving reproductive potential will produce important benefits for some long-term endangered species propagation programs. The genetic management programs so well demonstrated in domestic livestock are still in their infancy for exotic wildlife. The

reason is that captive husbandry must first be established, followed by basic reproductive and behavioral research. These programs can only be accomplished when we understand in biological terms the animals we are trying to preserve. That includes a knowledge of genetics, reproduction, immunology, pathology, clinical medicine, physiology, metabolism, energetics, nutritional requirements, etc. When these basics are well-understood, we can move and are moving into the consideration and application of advanced reproductive technology, including artificial breeding, gamete storage, sexing, and transplantation. We are confident that the future for many rare and endangered species will be enhanced through advancing reproductive and other bio-technologies. We point to the following partial list of successes:

Artificial Insemination: Giant panda, gorilla, Speke's gazelle, Persian leopard, guanaco, Sarus crane, and many others.

Embryo Transfer: Bongo/eland; guar/domestic cow; Bengal tiger/African lion; quarterhorse/zebra; and homologous transfers with baboons, rhesus monkeys, water buffalos, and elands.

In Vitro Fertilization: Primates (baboon).

Cytogenetics: Many look forward to the day when frozen embryos can be successfully thawed. When this is accomplished we can begin to consider gamete retrieval from wild free-ranging animals for the purpose of improving the genetic base of those in captive environments (and vice versa).

Educational Function

We note with dismay that science education is deteriorating as an educational base. Students are taking fewer courses in science, and fewer courses are being offered. And regrettably, we are experiencing a serious shortage of qualified

teachers. Of course, declines in student achievement are being documented. Zoological parks and aquariums, as providers of quality educational resources, are responsive to the widespread concerns over educational quality. We believe that the learning process should build personal "data bases" through a continuum of experiences found in the school curriculum, and augmented by a community's scientific resources. As partners in the educational enterprise, we are important resources for scientific learning. We are seeking to fulfill our educational responsibilities in the area of scientific literacy through the integration of our resources within the curriculum and other programs designed for American students at all educational levels.

Zoological parks and aquariums act as living classrooms for some 20 million school children every year. In these "classrooms" students are instructed through a "hands-on" approach.

The educational programs at Sea World are truly representative of the very best that the zoological community provides. As an example of, in our case, the "get wet" approach to education practiced at Sea World, consider the following:

Since the development in 1972 of "Exploration Breach", Sea World's formalized educational program for elementary through collegiate levels, over 2.5 million students have had the opportunity to directly experience and learn about marine life at one of the three Sea World parks as part of their curriculum. Other programs include: "Underwater Friends" for grades K-3; Youth Awards, for Campfire, Scouts, and other youth groups; Career explorations; "Interworlds" for students K-4; and in-depth studies for high school and college students (many in cooperation with the University of California, San Diego; San Diego State University, and the University of Florida system.) Sea World also provides continuing education units which bring marine science instructors

to the classroom, and a preceptorship program for upper level veterinary medical students interested in zoological medicine.

In recent years, several very popular special programs have been developed. Gifted students' programs are presented for qualified students in grades K-6. Three special education programs are offered for mentally-challenged, visually-impaired and severely disabled students. Each is a multi-sensory program designed for students who benefit from the individual approach. Sea World's Education Department also offers free curriculum aids and teacher orientation programs.

In addition to the organized education programs, trained interpreters/narrators are stationed at all major animal exhibits to answer visitors' questions and present educational information. Other educational materials are presented in our award-winning graphics displays located in exhibit areas.

Recreational Function

As our society become more urbanized and crowded, zoological parks and aquariums will provide the only available exposure to the world of nature for increasingly large numbers of people. Currently, these institutions accommodate annually over 110 million out of a nationwide population of 239 million. We realize that there are recreational activities that offer the public encounters with wildlife in natural settings, i.e., safaris, oceanic cruises, outings in natural parks, etc. Our programs are not designed as substitutes for these experiences, but rather as a complement to them. However, unlike most wilderness experiences, where wildlife is only partially visible or otherwise inaccessible, our programs afford the public with opportunities to personally experience the beauty, intelligence, and agility of these wildlife forms. This exposure is especially signifi-

cant to those visitors who have limited opportunities to experience such wildlife in natural settings—those living in large cities, the impaired, the young, the elderly, and the impoverished. Experiencing wildlife only through one-dimensional photographs cannot replace the sensation one feels as the curious trunk of an elephant grips your fingers, or at the touch of a satiny-smooth dolphin, glistening before you. Such experiences form lasting bonds of affection . . . and they're great fun!

Whether directly, through the proceeds of an admission charge, or through other means such as taxes, the recreational function is the means through which our educational and research functions are financed. It is a function that is important.

Conclusion

The purposes for which we exist and serve are necessary. Our purpose is reflected through our focus on research, education and recreation. Through our research projects, we have made important advances in captive husbandry and propagation programs, while contributing information vital to basic and applied wildlife science. In addition, we cooperate with local, state, federal and international governments, and the academic community, and have a long and impressive record in the recovery and rehabilitation of diseased and injured wildlife. Hopefully, these advances will continually increase our ability to generate information for the detection and management of environmentally-related changes to natural ecosystems, offering better and more widespread protection of our wild fauna.

In the spirit of combining scholarship with showmanship, we combine educational and recreational programs. This is done with a strong sense of responsibility for conveying ecologically-sound and important information to the public. In this way, we endeavor to promote greater awareness, understanding and concern for

wildlife and their natural environment, with the hope of contributing to a more informed public, and thus building a more responsible society.

Charles Lindbergh knew that nature is like a "canary in a coal mine." That its decline signals our own. He was, and we are, concerned. We believe he would have recognized the roles we play in the conservation of nature and in our contributions to scientific knowledge. And we also believe that he would have endorsed such sites for public education and recreation,

where wildlife can be maintained in settings that give them a good chance for long-term survival. As bridges of learning between man and nature, we honor the spirit and philosophy of Charles Lindbergh.

I've enjoyed this opportunity to speak to you, and I hope you will take some time to visit Sea World while you are in Orlando, and observe how the discoveries of science and the products of technology are preserving and improving the quality of life. Thank you.

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The Role of Sustainable Wildlife Use in Conservation and Development in the Tropics

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Upon reading the theme for this symposium, "Technology and Environment: The Search for Balance", I thought I might appropriately entitle my talk, "Technology and Wildlife: The Search for Sustainable Use", for the problems and solutions to the sustainable use of wildlife exemplify that search for balance between development and biological diversity.

What do we mean by the term "sustainable use of wildlife resources"? By sustainable we mean that the use made of a wildlife population is at such a level that the use can be maintained indefinitely; that is, the use does not exceed or destroy the population's ability to reproduce and replace itself. Use can mean a broad array

of things, from the hunting or trapping of animals for food, fur or sport, to bird watching. Wildlife, in the broadest sense of the term, can mean any wild animal or plant, terrestrial or aquatic.

Sustainable wildlife use stands at the crossroads of wildlands conservation and human technology and development. In simple terms, we can think of the sustainable use management of wildlife as human society knowledgeably manipulating wildlife to produce, indefinitely, any number of goods and services benefiting human development.

I would like to focus on wildlife use in the tropics, where the biggest challenges are today and where it will have the big-

gest impact on both development and biological diversity. I will specifically talk about Latin America where I work.

There are three points I wish to make today concerning wildlife use:

1. The actual and potential contribution of wildlife to human development in the American tropics is underestimated by national and international agencies concerned with human development, and, because of this, development is bound to fail in many areas because sustainable wildlife use is not incorporated into the development plan.

2. The development of wildlife management in the American tropics will require innovative techniques and new concepts in natural resource management, for which the North American experience can provide only limited models.

3. Wisely implemented sustainable use programs of wildlife will be critical in meeting the challenge of conserving the vast biological diversity of the tropics.

The importance of wildlife in meeting basic human needs is, of course, most obvious in the case of indigenous peoples. Native Indians of the American tropics depend on fishing and hunting to meet their protein requirements, and on a variety of plant products for food, shelter and medicinal needs. Native peoples are, indeed, experts at extracting from a cornucopia of plants and animals all of their basic necessities and commodities. Unfortunately, most of this native knowledge about tropical wildlife management has remained within the domain of indigenous groups and a few anthropologists. Native expertise has been largely ignored by government agencies in charge of natural resource management and land use planning, most probably because it is incorrectly seen as unsophisticated, unapplicable to current societal needs, and producing little of economic importance for the country.

Colonists that have settled in tropical forest regions have also become dependent on local forest resources. In rural Amazonian Peru, more than 85% of the

animal protein consumed by colonist villages is wild, of which more than two thirds is from fish (Pierret and Dourojeanni, 1967; Rios et al., 1973). This dependence by colonists as well as indigenous people on wild sources of protein is a pattern found throughout Amazonia, both in rural communities and in cities, and to a lesser extent in rural Central America. Nevertheless, technology transfer from indigenous peoples to colonist populations in the Amazon must be enhanced to enable the diversified and sustainable use of forest and river resources practiced by many indigenous groups to be more broadly tested and applied.

Some species also have tremendous potential for providing expendable income for rural inhabitants and for contributing to a country's trade balance. One species currently under research is a large lizard of the genus *Tupinambis* which is found throughout much of South America, but is particularly abundant in northern Argentina where it is hunted for its valuable skin and meat. Argentine export figures show that an average of 1–1.5 million *Tupinambis* skins leave the country every year, with a total export value of 10–15 million dollars (G. Hemley, personal communication). Yet, only within the last 2 years has any concerted effort been made to understand the basic biology and economic importance of this species. Preliminary calculations indicate that protecting the chaco forest for *Tupinambis* management may produce much greater economic returns for local inhabitants than conversion of the forest for cattle (D. Werner, en lit.).

One might ask if any management is necessary. Can't these species hold their own? Experience answers that heavily harvested species cannot sustain themselves without management. In fact, many Amazonian species of potentially great importance for economic and/or subsistence uses have been driven close to extinction by overharvesting within the last 50 years. Among the most important, for example, are the American and Orinoco crocodiles. The high value of their skins stimulated intensive